

# Lawrence Livermore National Laboratory

## Energy and Environment

*Lawrence Livermore National Laboratory (LLNL) conducts research to help meet the nation's and the world's ever-increasing demand for energy while confronting climate change and promoting environmental sustainability.*

Throughout history, energy has been the driver of economic growth, the source of military power, and the main determinant of the scale and success of a society. Civilizations have flourished in regions with abundant energy resources and struggled in places without. Today, the geopolitics of energy are influenced greatly by the fact that most of the principal energy consumers are not the principal energy producers.

The technological developments that have shaped the modern era—manufacturing, transportation, telecommunication, computing and myriad facets of contemporary life—are powered by fossil fuels. But fossil fuels have a serious downside—namely, damage to the environment. Even “clean” fossil fuel technologies release large quantities of carbon dioxide, contributing to global warming and climate change.

The Laboratory develops technical innovations and makes scientific breakthroughs to reduce the environmental impact of fossil fuels, to expand the use of alternative energy resources and to create new energy sources for the future. The Laboratory also evaluates the implications of energy use decisions, devises technologies for mitigating the environmental impacts of energy use and investigates the processes that influence global climate and drive climate change, including the effects of human activities.

### Clean Fossil Fuel Technologies

LLNL's fossil energy research program focuses on technologies that can increase yield, reduce environmental impact and exploit currently inaccessible resources. The Laboratory is a globally acknowledged leader in underground coal gasification, a process for converting deeply buried coal seams into gas without the surface disturbance of coal mining or the polluting byproducts (e.g., sulfur) of coal-fired power plants. To address the problem of greenhouse gas emissions, LLNL scientists and engineers, in collaboration with industry partners, develop technologies for capturing carbon dioxide from industrial flue streams and safely storing it underground.

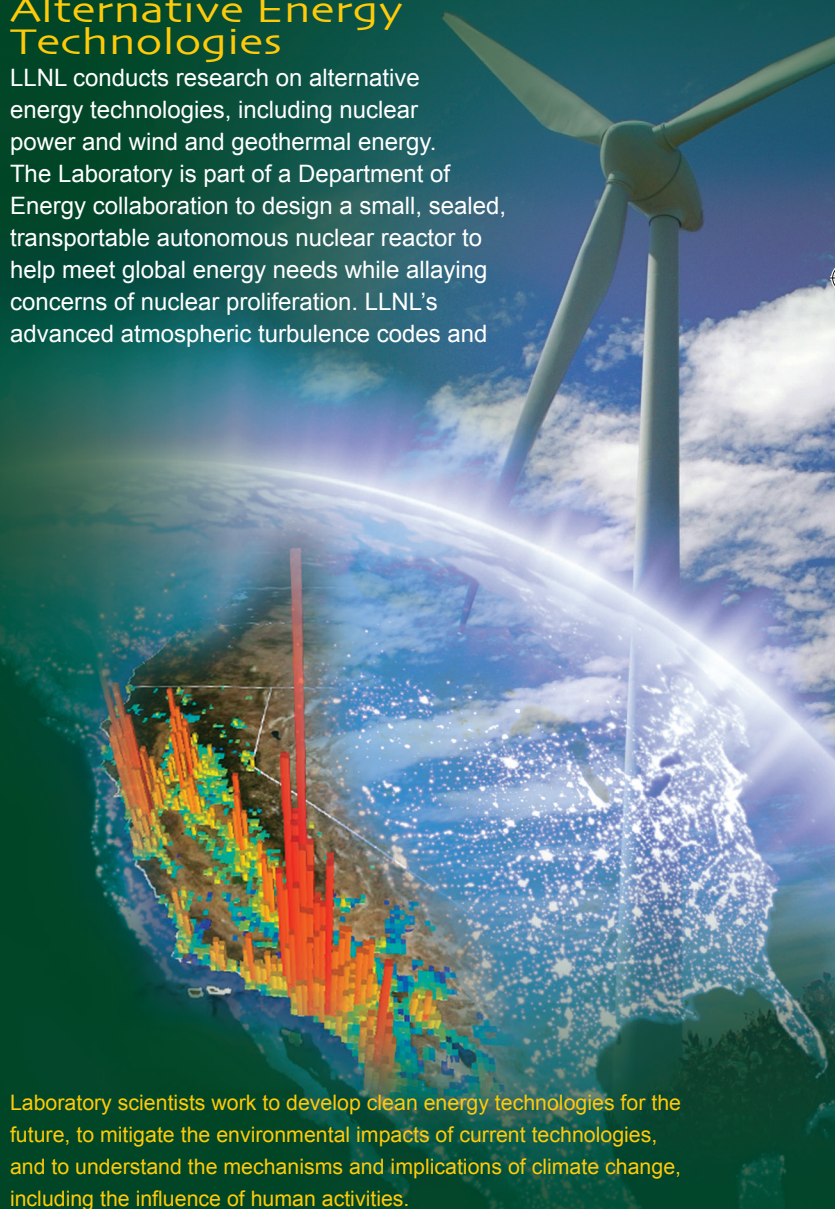
### Improved Transportation Technologies

Transportation accounts for nearly 30 percent of U.S. energy consumption, and advances here can have a major impact in increasing the nation's energy security and reducing its carbon footprint. LLNL collaborates with other laboratories, universities and industry to evaluate options for improving the aerodynamics

of tractor-trailers rigs; calculations indicate that halving the drag of these vehicles could increase their fuel mileage by 12 percent, saving the nation more than \$10 billion in diesel fuel costs annually. Laboratory scientists also develop technologies, such as new nano-materials for high-pressure hydrogen storage, that are aimed at making hydrogen-based transportation a reality.

### Alternative Energy Technologies

LLNL conducts research on alternative energy technologies, including nuclear power and wind and geothermal energy. The Laboratory is part of a Department of Energy collaboration to design a small, sealed, transportable autonomous nuclear reactor to help meet global energy needs while allaying concerns of nuclear proliferation. LLNL's advanced atmospheric turbulence codes and



Laboratory scientists work to develop clean energy technologies for the future, to mitigate the environmental impacts of current technologies, and to understand the mechanisms and implications of climate change, including the influence of human activities.



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LLNL expertise in geophysics and seismology is applied to research efforts in geothermal energy and underground carbon sequestration as well as nuclear explosion monitoring.

weather prediction models are helping improve the efficiency of wind farm operations and turbine designs, and Laboratory expertise in earth science is shedding light on the forces at work in geothermal energy fields in order to maximize the energy that can be extracted.

### Energy for the Future

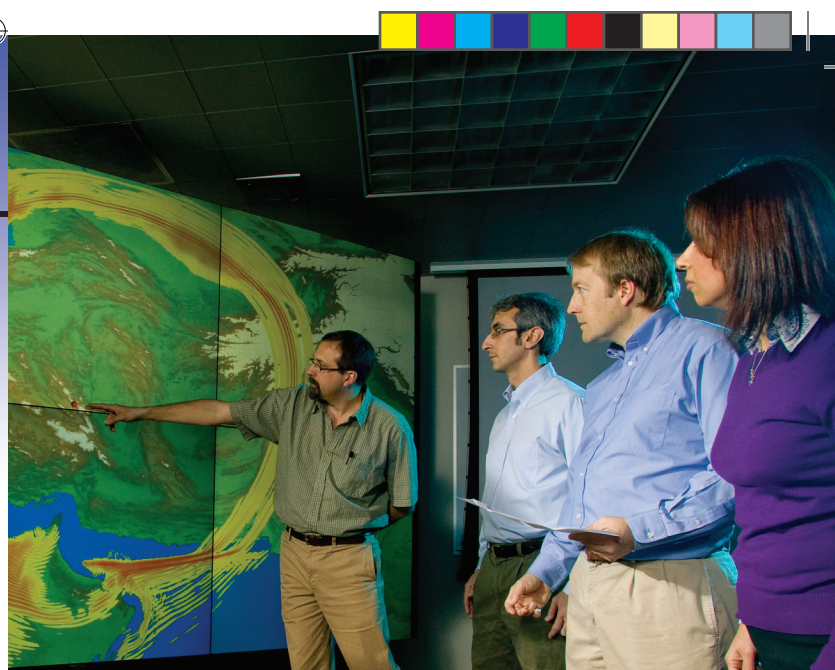
LLNL has been a leader in fusion energy research for more than 50 years. With the National Ignition Facility, scientists conduct experiments aimed at achieving fusion ignition in the laboratory. This accomplishment, expected within the next year or so, will lay the groundwork for decisions about fusion's potential as a safe, virtually limitless, carbon-free energy source.

### Energy Systems Analysis

The vast size and complexity of the U.S. energy system make it extremely difficult to compare technology and policy options and assess their impact on the overall system. LLNL applies its expertise in physics-based modeling and systems analysis to produce unbiased, detailed assessments of U.S. energy resources. These analyses map the flows of energy, water, material, carbon and money through large and complicated energy networks to understand the complete system response to energy use and energy production decisions and energy consumption trends.

### Environmental Restoration

The Laboratory develops technologies for cleaning up sites contaminated with gasoline and other hazardous materials. For



example, two LLNL-developed technologies, dynamic underground stripping and hydrous pyrolysis/oxidation, were used to clean up contaminated soil and groundwater at Southern California Edison's utility pole yard in Visalia, California, more than 100 years faster than originally expected. In 2009, the Visalia pole yard became the first Superfund site to be declared "clean" and formally removed from the Superfund list.

### Climate Modeling

LLNL is a world-recognized leader in atmospheric science and climate modeling. Laboratory researchers develop detailed computational simulations of climate to understand and forecast potential climate changes at regional to global scales. These simulations take into account the many interrelated factors influencing climate, such as ocean-atmosphere coupling, the effect of clouds, aerosol chemistry and so forth.

LLNL also directs the Department of Energy's Program for Climate Model Diagnosis and Intercomparison, which develops improved methods and tools for evaluating and comparing global climate models constructed by research institutions around the world. Laboratory climate researchers are key scientific contributors to the Intergovernmental Panel on Climate Change, which was a co-recipient of the 2007 Nobel Peace Prize.

For more information, contact the LLNL Public Affairs Office, P.O. Box 808, Mail Stop L-3, Livermore, California 94551 (925-422-4599) or visit our website at [www.llnl.gov](http://www.llnl.gov).

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